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ABSTRACT

The Science Assessment and Research Project conducted an assessment of the opportunities for computer learning in the nation's schools. As part of this study, 15,847 junior and senior high school students (13 and 17 years old) responded to a questionnaire regarding computers and computer usage. This is a summary of the findings: Opportunities for computer learning in our nation's schools are increasing, but inequities continue. Low-income, female, and rural students are especially disadvantaged in receiving computer experiences and computer literacy in school. Computer programming enrollment remains primarily limited to males attending computer-rich schools in large cities. Furthermore, over 60 percent of the senior high students and 70 percent of the junior high students have never had a chance to use a computer in school, as of the 1981-82 school year. Inequity in computer learning appears to have diminished for black students. Before interpreting this finding optimistically, however, further research should be done to determine the quality as well as the quantity of educational computing. (Author/GC)

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COMPUTER INEQUITIES IN

OPPORTUNITIES FOR COMPUTER LITERACY

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PREFACE AND ACKNOWLEDGEMENTS

The National Assessment of Educational Progress (NAEP) was established in 1969 for the purpose of conducting periodic assessments of students' knowledge of and attitudes toward various subject areas. National assessments in science were conducted by NAEP in 1969-70, 1972-73, and 1976-77.

Because of recent political decisions and financial constraints, NAEP postponed their next full-fledged science assessment until the late 1980's. Many science educators felt this hiatus would permit emerging problems to go unchecked. The purpose of the Science Assessment and Research Project (SARP) is to fill this void in national science assessments. Directed by Professor Wayne W. Welch and based at the University of Minnesota, SARP is responsible for overall project design, organization, and analyses of the 1981-2 science assessment. Technical assistance was provided by NAEP, who conducted the first three assessments in science. This project was made possible through a grant from the National Science Foundation. We would like to thank Andrew Molnar, Program Officer, at the Foundation for his support and guidance.

This report on "computer inequities" is based on several questions included in the 1981-82 National Assessment of Science which included testing of a national random sample of 18,000 9-, 13-, and 17-year-old students. A report entitled Images of Science summarizing the 1981-82 Nation Assessment in Science is available from Dr. Wayne W. Welch, 210 Burton Hall, University of Minnesota, Minneapolis, MN 55455.

EXECUTIVE SUMMARY

Opportunities for computer learning in our nation's schools are increasing, but inequities continue. Low-income, female, and rural students are especially disadvantaged in receiving computer experiences and computer literacy in school. Computer programming enrollment remains primarily limited to males attending computer-rich schools in large cities. Furthermore, over 60% of the senior high students and 70% of the junior high students have not ever had a chance to use a computer in school, as of the 1981-82 school year. Inequity in computer learning appears to have diminished for black students, however before interpreting this optimistically further research should be done to determine the quality as well as the quantity of educational computing.

INTRODUCTION

Last year 58% of the nation's school districts had microcomputers for student use, and if the growth rate continues, 85% of all districts will be using microcomputers this school year. These statistics come from Quality Education Data of Denver, Colorado, which also found that last year 37% of all 83,700 schools (separate school buildings) in the United States had at least one micro for students.

The sharp increase in school computers is no secret, in fact this summer both Popular Computing and Personal Computing magazines came out with special issues on "the educational crises." Popular Computing (August, 1983) said "Changes are taking place so rapidly that it's not at all clear who's in charge....The frightening answer may well be that no one's in charge--just innovation for its own sake." Quite obviously this is not true of every school district, but with such rapid technological change, there may be undesired educational changes taking place.

One such undesired effect of the school computer movement is computer inequity, especially unequal access to computer learning as a consequence of social and economic status. Many writers have expressed concern that if school computing opportunities are not provided to the less advantaged sectors of our society, microcomputers will serve to create even greater disparity between the haves and have nots (Nathan, 1983). Others have noted that the educational system may not provide equal computer opportunities for women and minorities.

To the extent that computer literacy and computer expertise are necessary for success in getting and keeping jobs, computer inequity is a serious problem. The fact of the matter is that not only is computer literacy important for success in the world of work, but computer literacy is also becoming essential for successful citizenship and useful for every

day living. Educational computer inequity threatens to separate groups and communities by giving some people more effective tools for living in the age of computer information systems.

ASSESSMENT METHODS AND PROCEDURES

Each year National Assessment selects respondents at ages 9, 13, and 17 using a deeply stratified, multistage probability sample design. This sample design guarantees that each respondent represents a known fraction of the entire population at that age level by weighting each respondent's performance inversely to his or her probability of selection. On this basis it is possible to make appropriate generalizations about the entire population of 9-, 13-, and 17-year-olds enrolled in school (NAEP, 1979, p3).

The rationale for selecting 9-, 13-, and 17-year-olds for assessments is that these age levels designate educational milestones attained by most students. By age 9, for example, students have been exposed to the basic program of primary education. By age 13 most students have finished elementary school education, and by 17 most are completing their secondary education. In general terms, we refer to the three age levels as elementary, junior high/middle school, and high school students.

The total testing involved 18,000 students (15,847 students age 13 or 17) located in approximately 700 schools in the United States. All tests were given by exercise administrators. A timed, paced tape was used simultaneously as students read the questions. This insured uniformity of testing conditions and allowed all students the same time to answer the items.

The questions pertaining to computers and computer inequity were asked of 15,847 13- and 17-year-old students during the 1981-82 school year. The students were all enrolled in either public or private schools at the time of testing.

FINDINGS

INEQUITY AND WEALTH

According to a survey of all schools in 1983, Quality Education Data, Inc., reports that the 12,000 wealthiest schools are four times as likely to have microcomputers as are the 12,000 poorest schools. Our findings from the 1982 assessment show that the number of students enrolling in computer programming is much lower in schools that qualify for Title I assistance than those that don't. (Schools qualify for Title I assistance by having a large percent of the parents with income below the poverty line.) Age 17 students were asked if they had studied computer programming, 11% said they had done so for a semester or more, which is up slightly from 1978 when only 7% said they had. Figure 1 gives the enrollment trend line from 1978 to 1982 showing that while the number of students taking computer programming classes is on the rise, in 1982 only 7% of students in Title I schools had taken programming while 14% of students in other schools had taken such classes. The graph depicts a widening in the trend lines indicating a growing gap between the schools in wealthier as opposed to poorer communities. This increased disparity results from the fact that during the past four years the poorer schools have had only a negligible rise in enrollment in computer programming classes.

In the 1982 Science Assessment, students were asked if they had "used computers or computer terminals" in their schools. Thirty-three percent in the senior high schools but only 23% in the junior high schools said they had used computers or computer terminals in school. If we look only at rural and "ghetto" (disadvantaged-urban) communities, the number of students getting to use computers is much lower than those from other types

Figure 1

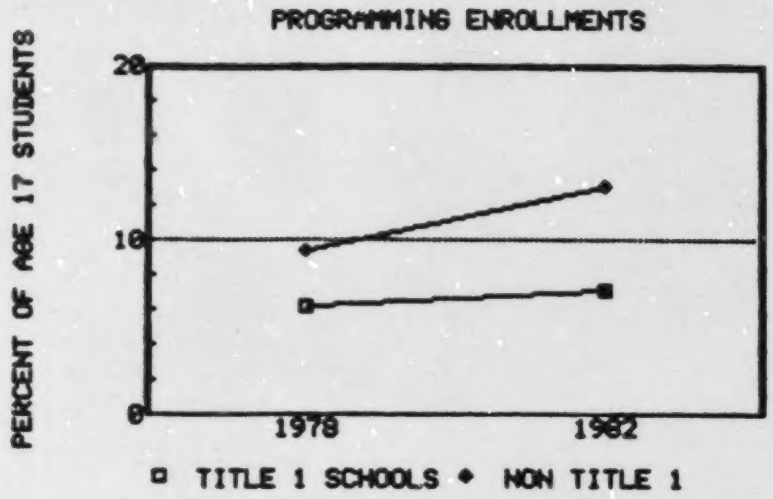
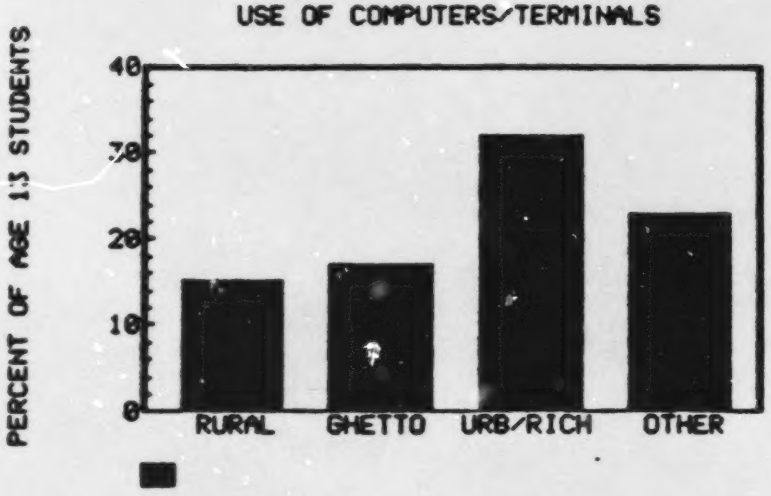


Figure 2



of communities. "Rural" is defined as farms or towns with under 10,000 population. "Ghetto" consists of high-unemployment areas within cities of at least 200,000 population. As shown in Figure 2, among students at age 13 less than 17% of the students from rural and ghetto areas report use of school computer equipment. In contrast 32% of the 13-year-olds living in "urban/rich" areas, those areas in large cities of at least 200,000 which have an unusually high proportion of residents who are employed in professional or managerial jobs, report use of computers in schools.

INEQUITY AND COMMUNITY SIZE

A large, statewide computer literacy assessment in Minnesota failed to find any large, substantial differences in school computer utilization when comparing students living in different size towns and cities (Anderson, Krohn, Smith-Cunnien, 1982). Minnesota may be unique however, since at that time the State provided free telecommunications for all schools that wanted to use the central, time-sharing computer system. Such support for instructional computing makes student access to computers for learning much more feasible.

Our assessment data reveal that nationwide the smaller communities do not provide as many opportunities for computer education as the larger ones. For example, only 18% of junior high school students in small towns report school computer use, but 26% of the junior high students in large cities have such access.

Inequity in rural areas in much more noteworthy in the area of programming enrollment and these data are given in Figure 3. This graph shows that the growing computer inequity in computer instruction affects mostly the big, inner cities and the rural areas. The trend lines for these two parts of the country are mostly flat, but the trends for the

Figure 3

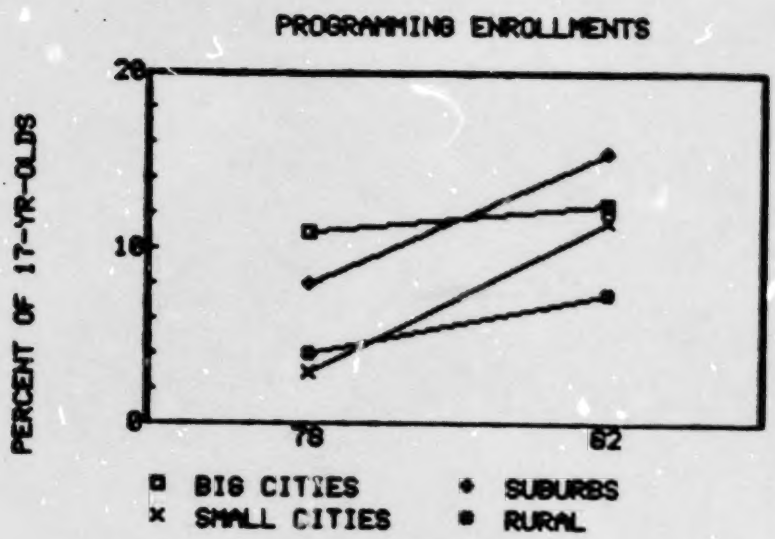
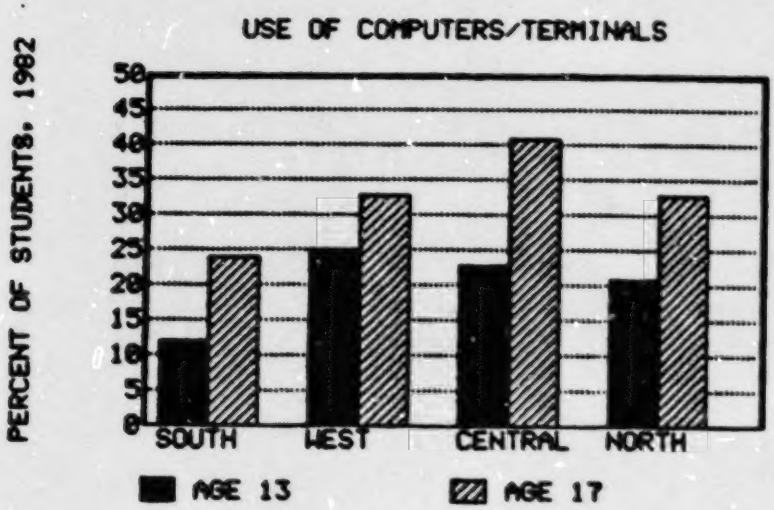


Figure 4



suburbs and small cities rise sharply. As of 1982 17% of the suburban high school students had enrolled in computer programming for at least one term, but only 6% (less than 1/2) of the rural students had done so. The gap between the city and the rural areas appears to be widening, although the evidence for this is not very large.

INEQUITY AND REGION

Student computer experiences were examined separately for each of four major regional divisions of the United States. These regions were defined as follows: the West included all states west of Montana, Colorado, Oklahoma and Texas; the Central region included those states bounded by North Dakota, Kanasas, and Ohio; The South contained all states southeast of Arkansas, Kentucky, and West Virginia; the North included all states northeast of Pennsylvania.

The students living in the South are much less likely to have used computers in school than the students living in other parts of the country. This is especially true for junior high school students but also true for age 17 high school students. The magnitude of the regional differences is shown in Figure 4. Age 13 students in the South had only 12% with school computer experience, however twice that number (24%) of the students in the West had received such experience. For 13-year-olds the Central and North are roughly comparable to the Central region with respect to opportunities to use computers in the schools.

INEQUITY AND GENDER

Gender differences in computer education have received considerable attention but little systematic research. Two exceptions to this are an experiment by Lockheed, Nielsen, and Stone (1983) and a statewide assessment by Anderson, Klassen, Krohn, and Smith-Cunnien (1982), and these studies report that young women in secondary schools are less likely than

Figure 5

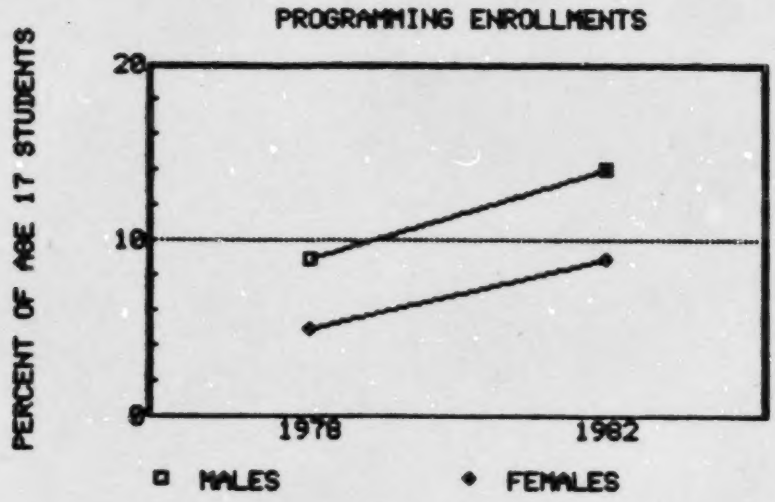
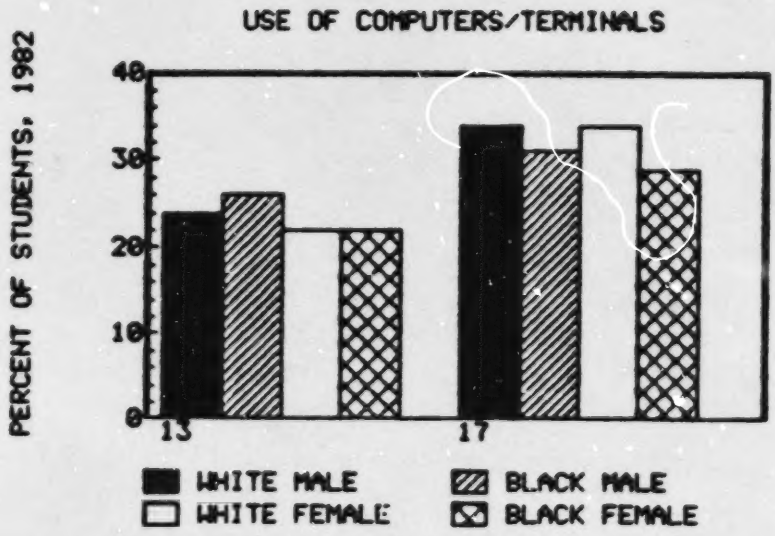


Figure 6



young men to spend time with computers and to enroll in computer classes.

Our 1981-82 National Assessment in Science provides additional data on gender differences. While no significant differences are found in the number of males and females reporting any use of computers in school, a substantial gap remains in signing up for computer programming classes. As shown in Figure 5 females are less likely to take these courses than are males; 8% of the females and 14% of the males have enrolled in a programming course for at least one semester. This difference has remained constant since 1978 as depicited in the trend lines (Figure 5).

Undoubtedly some portion of this difference between the two genders results from cultural socialization, however there may be structural factors in the schools that inhibit females from taking advantage from computer opportunities. For example, counselors may not recommend computer courses for the girls, and very often the computer programming course is an advanced math elective that requires prior mathematics courses.

INEQUITY AND RACE

The Minnesota assessment (Anderson, et. al., 1982) found differences in computer literacy and computer use by race. Hueftle, Rakow, and Welch (1983) report that black students are much less likely than white students to report engaging in science-related activities. While the National Assessment found some racial inequity on computer exposure in 1978, our recent results reveal no signficiant difference between black and white students. Figure 6 shows the percent of students with school computer use comparing sex and racial groups. It can be seen from this display that no substantial racial or gender difference exists. This apparent equity between black and white students is also found for enrollment in computer programming courses.

These findings on black students may seem to be inconsistent with the previously discussed findings on low-income inequity. Further research should be done on this question, but one possible explanation that has been offered is that special programs for minority students have provided them with new opportunities for exposure to computer technology in the schools. It has been suggested however that this exposure is limited in quality and not always beneficial. Specifically, some educators have bemoaned the extensive use of highly-rigid, drills (CAI) for minority students. In contrast the students in the wealthier schools seem to have more opportunities for creative inquiry and discovery modes of computer learning.

A COMMENT ON IMPLICATIONS

If as the prevailing ideology suggests, computer literacy is a worthy goal for all students, then there is a corresponding responsibility to formulate the means by which it can be attained. The variety of dimensions on which this study has identified computer inequity point to the impossibility of removing inequities and achieving universal computer literacy without the implementation of policy changes at all levels of the educational system: national, state, community, district, school, and classroom. If computer literacy is not for everyone, then the grounds on which students are to be chosen for computer training should be determined. The consequences of such decisions must be carefully considered.

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